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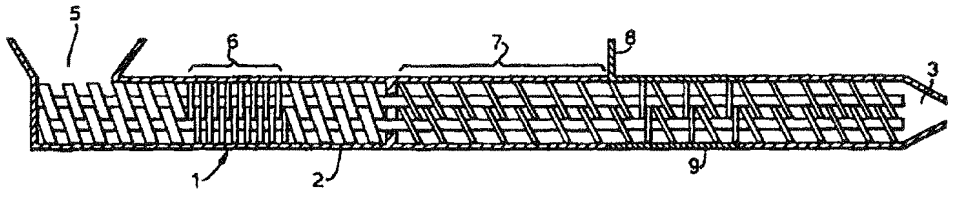

(57) Abstract

a method and apparatus for the continuous preparation of a frozen aerated confection whereby the ingredients are homogenised, pasteurised on zones (6) and (7), frozen and aerated on zone (9) in a screw extruder (2).

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METHOD FOR CONTINUOUS PREPARATION OF A FROZEN AERATED CONFECTION

Technical Field of the Invention

The invention relates to the manufacture of a frozen food product and a device for use in this manufacture.

Background to the Invention

The present invention relates to improved methodology to prepare frozen confectionery products such as ice-cream.

Continuous processes for the production of frozen confectionaries such as ice-cream usually comprise the following steps:

a) homogenising of ingredients
b) pasteurisation
c) cooling
d) freezing and aeration
e) extrusion
f) (optional) deep freezing

Normally the homogenisation step takes place in a first vessel, followed by continuous pasteurisation followed by cooling. The mixture is then transferred to a freezer, for example a scraped surface freezer where the product is frozen prior to extrusion and further handling.

Screw extruders such as single screw and twin screw extruders are widely used in the chemical industry for example in the production of plastics. It has also been proposed to use single screw or twin screw extruders in the freezing of ice-cream, see for example EP 561 118 and EP 401 512.

Surprisingly applicants have now found that it is possible in a continuous process for the production of frozen confectioneries such ice-cream to carry out the steps of homogenisation, pasteurisation, freezing and aeration all in one apparatus. Such a device is highly desirable since it allows the continuous preparation of ice-cream under clean closed conditions without the need of very high investments. Until now this was generally only achievable when using batch processes for ice-cream preparation.

Surprisingly it has been found that the steps of homogenisation, pasteurisation, freezing and aeration of ice-cream can all take place in a screw extruder. This screw extruder can be either a single or multiple screw extruder. Preferably however a twin screw extruder is used.

Preferably the screw extruder consists of an outer barrel. This barrel is preferably of elongated shape. For example the barrel may be cylindrical or tapered. The length of the barrel may vary but will mostly be between 50 cm and 1000 cm. Usually the barrel will be made of metal e.g. stainless steel.

Within the barrel are one or more screws for transporting the ice-cream mix through the extruder and for providing the desired pressure onto the mix. Although it is possible that the screw is homogeneous throughout the extruder in most cases it may be advisable to vary the screw parameters over the barrel. For example the angle of the screw and the lead pitch may be changed over the extruder.

Generally along most of the length of the barrel, the screw will be in close alignment with the barrel to allow

the necessary pressure to be built up. However in areas wherein a temporary reduction of pressure may be advantageous (e.g. during pasteurisation) one way of achieving this could be to ensure that there is an empty space between the screw and the barrel.

Along the barrel are various openings for feeding in material. For example at the beginning of the extruder will be one or more inlet openings for feeding in the components of the ice-cream. Further on at the barrel will be at least one opening for the inlet of air during the aeration process. Preferably the product is aerated to an overrun of 40 to 300 %, more preferred 60 to 200 %, most preferred 80 to 180 %.

If desired towards the end of the barrel may be further inlet openings for example to add fruit or nuts to the frozen ice-cream, or to mix another pasty substance such as sauce into the ice-cream.

Furthermore the barrel will be provided with means for heating part of the barrel (and it contents) to effect pasteurisation. These means are preferably located after the inlet openings for the ice-cream ingredients and before the inlet opening of the air. Any suitable system for applying pasteurization heat can be used e.g. coil heating, inductive heating, microwave etc.

The barrel will also provide cooling means to allow the cooling and freezing of the ice-cream mix after pasteurisation. A suitable system includes the freezing of the ice-cream ingredients while at the same moment aerating the mix. This can be achieved by having the aeration inlet in the close vicinity of the freezing means. For example after pasteurisation, the ice-cream mix may be cooled, thereafter the air may be fed in,

whereafter the mix is frozen. Any suitable means for freezing may be used, for example a cooling liquid may be applied to the outside of the barrel (e.g. brine, methanol, propyleneglycol, carbon dioxide or liquid nitrogen). Alternatively an edible cooling medium may be added into the mix via a cooling inlet e.g. liquid oxygen, liquid nitrogen or solid carbon dioxide.

At the end of the barrel there will be an extrusion opening. For some applications it may be desirable to have an empty space at the end of the barrel where no screw is present. This allows the depressurisation of the ice-cream prior to extrusion.

Preferably the continuous freezer system is provided with a control system ensuring the dosing of ingredients, the temperature control and the pressure within the freezer.

Accordingly in a first aspect the invention relates to a methcd for the continuous preparation of a frozen aerated confection whereby the ingredients are homogenised, pasteurised, frozen and aerated in a screw extruder.

Preferably the frozen aerated confection of the invention is a milk or fruit based frozen aerated confection such as ice-cream, frozen yoghurt, sherbet, sorbet, and frozen custard.

Suitable ingredients and their preferred levels for such a frozen aerated confection are for example:Ice-cream/custard: milk fat 2-20 wt%, milk solids non fat 2 to 15 wt%, sugar or other sweeteners 0.01 to 35 wt%, stabilisers/ emulsifiers 0 to 2 wt%, flavours 0-5 wt%, eggs 0-20 wt%, water 30 to 85 wt%.

The time for homogenising the ingredients may vary in a

broad range for example 2 seconds to 2 hours, most conveniently 10 seconds to 20 minutes.

Pasteurisation preferably takes place at a temperature of 65 to 95°C for a period of 1 second to 2 hours. Preferably the pasteurisation temperature is chosen such that pasteurisation is achieved within a period of between 10 seconds and 1 minutes.

Preferably the mixture is then cooled to ambient temperature e.g. using a cooling liquid followed by aeration and freezing.

Preferably the product is then extruded at a temperature of from -5 to -30 °C, more preferable from -10 to -25 °C.

The shear applied to the mixture may vary along the barrel. For example the homogenisation preferably takes place at relatively high shear, while the final freezing step is preferably carried out under low shear.

The invention will be further illustrated by means of the following example:

Example 1

Figure 1 schematically represents a extruder of the twin screw type according to the present invention.

The extruder consists of a barrel (1) of generally cylindrical scape. Within the barrel is a double screw (2) along the barrel except for an open de-pressurisation space (3), the blades of the screw are in direct contact with the inside of the barrel. The barrel is orientated horizontally and has an extrusion opening (4) at its right hand side. At the left hand side of the barrel is an inlet opening (5) for mixing in the ice-cream ingredients. Further along the barrel are heating means (6, 7) for heating and pasteurising the ice-cream mix. Air inlets (8) ensure that the aeration gas is introduced into the system, while cooling means (9) ensure the freezing of the mix. The entire barrel is provided with a control system (not shown) to regulate, temperature, pressure, speed etc

Example 2

An ice-cream of the following formulation can be prepared with the screw freezer of example 1:

Skimmed milk powder	10	wt%
Sucrose	13	wt%
Maltodextrin DE 40	4	wt%
Butter Oil	8	wt%
Locust bean gum	0.144	wt%
Carrageenan	0.016	wt%
MGP	0.3	wt%
water	balance	

The ingredients are mixed at ambient temperature through inlet (5). The mixture is then transported by means of the screw while continuously applying pressure, during transport homogenisation takes place until the mixture reaches the part of the barrel with the heating means 7. The mix is pasteurised for 30 seconds at a temperature of 90 °C. After leaving the heating zone the mixture cools to 5 °C. The air is introduced via inlets 8 before and during freezing by means of cooling means 9. The temperature of the product after freezing is -12 °C, the overrun is 75%. The product is then extruded at -12 °C.

CLAIMS

1. A method for the continuous preparation of a frozen aerated confection whereby the ingredients are homogenised, pasteurised, frozen and aerated in a screw extruder.

2. A method according to claim 1 wherein a twin screw extruder is used.

3. A method according to claim 1 or 2 wherein the frozen aerated confection is selected from the group of ice-cream, frozen custard, frozen yoghurt and sorbet.

4. An apparatus for the production of a frozen aerated confection comprising a single barrel (1) provided with at least one screw (2) and extruder opening (4), said barrel comprising inlet openings (5) and (8) for ice-cream ingredients and aeration gas and heating means (7) for pasteurisation, and cooling means (9) for freezing.

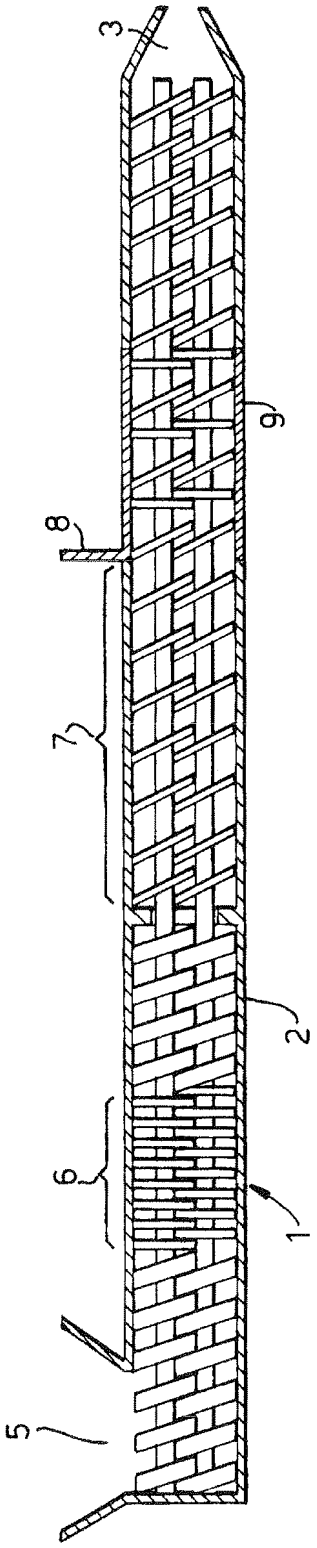

Fig. 1

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23G9/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

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